

# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : SEIKO EPSON CORP

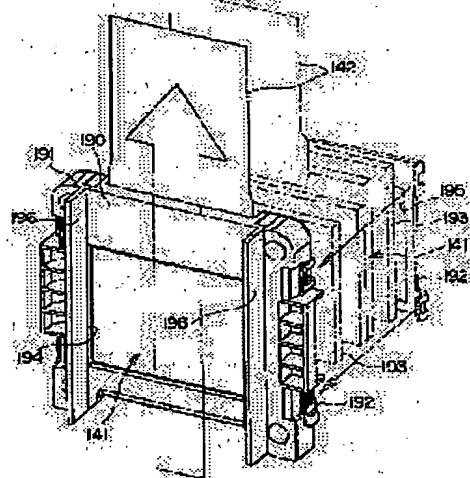
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(72)Inventor : KATO HISAMARO

## (54) OPTICAL MODULATING DEVICE AND PROJECTOR USING THE SAME

(57)Abstract: PROBLEM TO BE SOLVED: To securely improve cooling efficiency by suppressing partial cooling and an outflow of cooling air to others.

SOLUTION: A holding frame 190 which holds a liquid crystal panel 141 is provided with a couple of projection piece parts 196 which guide a flow of cooling air to a first frame 191 constituting the frame 190. The flow of the cooling air which is about to spread by whirling can be straightened to suppress the partial cooling of the liquid crystal panel 131 and the outflow of the cooling air to others. Further, the projection piece parts 196 are molded integrally with the hold frame 190 of the liquid crystal panel 141, so a gap, etc., is hardly formed between the liquid crystal panel 141 and projection piece parts 196 and the cooling air is guided almost without leaking to securely improve the cooling efficiency.



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CLAIMS

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[Claim(s)]

[Claim 1] Light modulation equipment which a periphery is light modulation equipment currently held by the maintenance frame, and is characterized by forming the air induction part to which it shows the flow of cooling air in said maintenance frame.

[Claim 2] Light modulation equipment characterized by the thing of said maintenance frame for which said air induction part is formed in the optical incidence side at least in light modulation equipment according to claim 1.

[Claim 3] Light modulation equipment characterized by forming said air induction part in both by the side of the optical ON outgoing radiation of said maintenance frame in light modulation equipment according to claim 2.

[Claim 4] It is light modulation equipment which is the band-like protruding piece section of the couple to which said air induction part projected in parallel mutually from the body part of a maintenance frame in light modulation equipment according to claim 1 to 3, and is characterized by preparing opening for the object for optical incidence, and/or optical outgoing radiation among these protruding piece sections.

[Claim 5] It is light modulation equipment which is the slot where said air induction part became depressed in the cross-section concave from the body part of a maintenance frame in light modulation equipment according to claim 1 to 3, and is characterized by preparing opening for the object for optical incidence, and/or optical outgoing radiation in this slot.

[Claim 6] Light modulation equipment characterized by preparing the extension section which extended to the opening side for blowdown to which said cooling air is supplied in light modulation equipment according to claim 1 to 5 in the edge of the upstream of said cooling air in said air induction part.

[Claim 7] It is the projector which is a projector equipped with the light modulation equipment which modulates light according to image information, and is characterized by said light modulation equipment being light modulation equipment given in said claim 1 thru/or claim 6 at either.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the projector equipped with the light modulation equipment which

modulates light according to image information, and such light modulation equipment.

[0002]

[Background of the Invention] Since thermal resistance is low as compared with light equipment, a power supply unit, etc. containing for example, a light source lamp, while the temperature of cooling air is low, it is necessary to cool promptly the light modulation equipment which constitutes the electro-optic device of a projector. For this reason, in the former, the inhalation-of-air fan has been stationed near the light modulation equipment, and the cooling air just attracted by this inhalation-of-air fan was first sprayed on light modulation equipment compulsorily.

[0003]

[Problem(s) to be Solved by the Invention] However, since it is sprayed so that the air for cooling may whirl around under the effect of a revolution of a fan in case cooling air is sprayed on light modulation equipment, the problem that a bias will arise is in cooling of light modulation equipment.

[0004] Since especially the spiral air for cooling is in the inclination which spreads toward the vertical outside, it has the problem that it is difficult to lead all the air for cooling to light modulation equipment, and the cooling effectiveness of light modulation equipment worsens.

[0005] Then, although arranging a baffle plate between an inhalation-of-air fan and light modulation equipment was also performed, since the leakage of cooling air arose from the clearance between a baffle plate and light modulation equipment, there was a limitation in raising cooling effectiveness.

[0006] The object of this invention is by suppressing partial cooling and the runoff to everything but cooling air to offer the light modulation equipment which can raise cooling effectiveness certainly, and the projector using this light modulation equipment.

[0007]

[Means for Solving the Problem] A periphery is light modulation equipment currently held by the maintenance frame, and the light modulation equipment concerning claim 1 of this invention is characterized by forming the air induction part to which it shows the flow of cooling air in said maintenance frame. With such a configuration, since the flow of the cooling air in which cooling air tends to be led with the air induction part of a maintenance frame, tends to wind an eddy around, and tends to spread is prepared, the flow to everything but cooling and cooling air toward which light modulation equipment inclined is suppressed. And since the air induction part is formed in the maintenance frame of light modulation equipment, between light modulation equipment and an air induction part, a clearance etc. is hard to be formed, cooling air is drawn without the leakage in abbreviation, and its cooling effectiveness improves certainly.

[0008] The light modulation equipment concerning claim 2 of this invention is characterized by the thing of said maintenance frame for which said air induction part is formed in an optical incidence side at least. With such light modulation equipment of a configuration, since the optical incidence side which is easy to generate heat rather than an optical outgoing radiation side is cooled good, cooling effectiveness improves more.

[0009] The light modulation equipment concerning claim 3 of this invention is characterized by forming said air induction part in both by the side of the optical ON outgoing radiation of said maintenance frame. With such a configuration, the both sides by the side of the optical ON outgoing radiation of light modulation equipment are cooled good, and cooling effectiveness improves further.

[0010] The light modulation equipment concerning claim 4 of this invention makes said air induction part the band-like protruding piece section of the couple which projected in parallel mutually from the body part of a maintenance frame, and is characterized by preparing opening for the object for optical incidence, and/or optical outgoing radiation among these protruding piece sections. With such a configuration, since the protruding piece section projects in band-like so that this clearance may be taken up even when a clearance is among other members which carry out contiguity opposite (it counters in the transparency direction of light) to a maintenance frame and this, runoff of cooling air is prevented and cooling effectiveness is maintained certainly.

[0011] The light modulation equipment of this invention according to claim 5 makes said air induction part the slot which became depressed in the cross-section concave from the body part of a maintenance frame, and is characterized by preparing opening for the object for optical incidence, and/or optical outgoing radiation in this

slot. With such a configuration, since there is no object for \*\* which makes the above protruding piece sections project in the clearance between other members which carry out contiguity opposite (it counters in the transparency direction of light) to a maintenance frame and this, such a clearance can be set up smaller and space-saving-ization of the perimeter of light modulation equipment is promoted by it.

[0012] The light modulation equipment concerning claim 6 of this invention is characterized by preparing the extension section which extended to the opening side for blowdown by which said cooling air is supplied to the edge of the upstream of said cooling air in said air induction part. with such a configuration, since it is led by the extension section shortly after cooling air blows off from opening for blowdown, the leakage of cooling air is markedly alike, and decreases, and cooling effectiveness improves substantially.

[0013] The projector concerning claim 7 of this invention is a projector equipped with the light modulation equipment which modulates light according to image information, and said light modulation equipment is characterized [ at said claim 1 thru/or claim 6 ] by being light modulation equipment of a publication either.

[0014] Therefore, as mentioned above, the cooling effectiveness of light modulation equipment improves certainly, and said object is attained.

[0015]

[Embodiment of the Invention] Hereafter, each operation gestalt of this invention is explained based on a drawing.

[0016] [The 1st operation gestalt]

1. The structure of the various optical system of a projector 100 where the light modulation equipment concerning the 1st operation gestalt of this invention was applied is shown in the structural drawing 1 of the optical system of a projector. This projector 100 is equipped with the integrator illumination-light study system 110, the color separation optical system 120, the relay optical system 130, the electro-optic device 140, the cross dichroic prism 150 as color composition optical system, and the projection lens 160 as projection optical system.

[0017] Said integrator illumination-light study system 110 is equipped with the light equipment 111 containing light source lamp 111A and reflector 111B, the 1st lens array 113, the 2nd lens array 115, the reflective mirror 117, and the superposition lens 119. After reflecting so that it may condense at a condensing point by reflector 111B, the flux of light injected from light source lamp 111A is made into abbreviation parallel light with the concave lens 112 arranged in the location the middle to a condensing point, further, is divided into two or more partial flux of lights by the 1st lens array 113, and carries out incidence to the 2nd lens array 115 by it. Each partial flux of light injected from the 2nd lens array 115 is changed into one kind of polarization light by the polarization sensing element 116. In addition, such a polarization sensing element 116 is introduced to JP,8-304739,A. Each partial flux of light changed into one kind of polarization light by the polarization sensing element 116 is mostly superimposed on the liquid crystal panel 141 (it is indicated as liquid crystal panels 141R, 141G, and 141B for every colored light) as light modulation equipment (light valve) of three sheets which constitutes the electro-optic device 140 mentioned later with the superposition lens 119.

[0018] Said color separation optical system 120 is equipped with two dichroic mirrors 121 and 122 and the reflective mirrors 123, and has the function to divide into the colored light of three colors of red, green, and blue two or more partial flux of lights injected from the integrator illumination-light study system 110 by mirrors 121 and 122. Said relay optical system 130 is equipped with the incidence side lens 131, a relay lens 133, and the reflective mirrors 135 and 137, and has the function to draw the colored light B separated by this color separation optical system 120, for example, blue glow, to liquid crystal panel 141B.

[0019] Said electro-optic device 140 is equipped with the liquid crystal panels 141R, 141G, and 141B used as the light modulation equipment of three sheets, with the liquid crystal panels 141R, 141G, and 141B of these three sheets, according to image information, it becomes irregular, and each colored light from which these were separated by the color separation optical system 120, using poly-Si TFT as a switching element forms an optical image. The cross dichroic prism 150 used as said color composition optical system compounds the image which was injected from said liquid crystal panels 141R, 141G, and 141B of three sheets and which was modulated for every colored light, and forms a color picture. In addition, the dielectric multilayer which reflects red light, and the

dielectric multilayer which reflects blue glow are formed in prism 150 in the shape of an abbreviation X character in accordance with the interface of four rectangular prisms; and three colored light is compounded by these dielectric multilayers. And the color picture compounded by prism 150 is injected from the projection lens 160, and amplification projection is carried out on a screen.

[0020] 2. the surrounding structure of light modulation equipment — in such a projector 100, the electro-optic device 140, the cross dichroic prism 150, and the projection lens 160 are unified as an optical unit 170. That is, the optical unit 170 is equipped with the head object 171 (a two-dot chain line illustrates in drawing 1) of the shape of a side face of L characters made from a Magnesium alloy.

[0021] In drawing 2, the projection lens 160 is fixed to the vertical plane 171A outside of L characters of the head object 171 with a screw, and the cross dichroic prism 150 which constitutes an electro-optic device 140 is being similarly fixed to the level surface 171B upside of L characters of the head object 171 with the screw.

Furthermore, the inhalation-of-air fan 180 is stationed at this level surface 171B bottom. The inhalation-of-air fan 180 attracts cooling air from the exterior through the inlet port of the lower case which a projector 100 does not illustrate, and makes cooling air blow off from each opening 172 for blowdown prepared in level surface 171B, and liquid crystal panels 141R, 141G, and 141B are cooled first.

[0022] 3. The periphery is held by the maintenance frame 190 so that the maintenance frame structure liquid crystal panel 141 of light modulation equipment may be expanded also to drawing 3 and may be shown: the metal made of the resin with which the maintenance frame 190 is arranged at an optical incidence side which engages with 191 in the four corners to the optical outgoing radiation side of 191; the 1st frame the 1st frame — tabular — the 2nd frame consists of 192, the 1st frame of a liquid crystal panel 141 is dedicated in the crevice of 191; and the 2nd frame of this is held down by 192: Under the present circumstances, between a liquid crystal panel 141 and each frame 191, 192, the cover glass 193 which consists of sapphire glass etc. is infix. The opening 194, 195 of the shape of a rectangle for optical ON outgoing radiation is formed in each frame 191, 192, respectively. In addition, the sign 142 in drawing is FPC (flexible printed circuit) connected to the liquid crystal panel 141.

[0023] The 1st frame of the protruding piece section 196 as an air induction part of an parallel couple is really mutually fabricated by 191: Each protruding piece section 196 is formed in band-like [which continued along the direction of the vertical in drawing of 191 the 1st frame], and as returned and shown in drawing 1, it projects from the body part so that the clearance between a liquid crystal panel 141 and the condenser lens 138 by the side of incidence may be divided. In drawing 2, the opening 172 for blowdown mentioned above directly under [between each protruding piece section 196] is located, and the opening 194 (drawing 3) for said optical incidence of a body part is located between the protruding piece sections 196. Through between the protruding piece sections 196 which incident light concentrates, the cooling air supplied from opening 172 mainly cools a liquid crystal panel 141 from an optical incidence side, and escapes from it up.

[0024] 4. According to the effectiveness book operation gestalt of an operation gestalt, there is the following effectiveness.

[0025] (1) In the maintenance frame 190 holding a liquid crystal panel 141; since the protruding piece section 196 of the couple which constitutes this and which shows the flow of cooling air to 191 is formed, the flow of the cooling air which is going to whirl around and is going to spread can be prepared, and the 1st frame of the runoff to everything but cooling and cooling air toward which the liquid crystal panel 141 inclined can be suppressed. And since the protruding piece section 196 is really fabricated by the maintenance frame 190 of a liquid crystal panel 141; a clearance etc. can be made hard to produce between a liquid crystal panel 141 and the protruding piece section 196; and it can draw cooling air without the leakage in abbreviation, and can raise cooling effectiveness certainly.

[0026] (2) Since the protruding piece section 196 is formed in the optical incidence side of the maintenance frame 190, it can cool the optical incidence side which is easy to generate heat rather than an optical outgoing radiation side good because incident light concentrates, and can raise cooling effectiveness more.

[0027] (3) Since it has taken up the clearance between projection levers from the body part to band-like so that the clearance between a liquid crystal panel 141 and the condenser lens 138 by the side of incidence may be

divided, the protruding piece section 196 can be prevented from missing horizontally the cooling air which circulates between the protruding piece sections 196, and even when there is such a clearance, it can maintain cooling effectiveness certainly.

[0028] The [2nd operation gestalt] The liquid crystal panel 141 concerning the 2nd operation gestalt of this invention is shown in drawing 4. In this liquid crystal panel 141, the soffit of the protruding piece section 196 of the maintenance frame 190 has extended further caudad, and this part that extended has become the extension section 197 attained to the opening 172 for blowdown of the head object 171.

[0029] Other configurations (the configuration of parts other than maintenance frame 190 and liquid crystal panel 141 is included) are the same as the 1st operation gestalt. In drawing 4, if attached to the same component as the 1st operation gestalt, the same sign as having used for explanation of the 1st operation gestalt is attached, and the detailed explanation is omitted.

[0030] In addition to the effectiveness of (1) – (3) mentioned above, there is the following effectiveness with such an operation gestalt.

[0031] (4) since the extension section 197 which extended to the opening 172 for blowdown is formed in the soffit of the protruding piece section 196, the cooling air which blew off from opening 172 can be promptly drawn between the protruding piece sections 196 by the extension section 197, the leakage to everything but cooling air can be boiled markedly, can be lessened, and cooling effectiveness can be raised substantially.

[0032] The [3rd operation gestalt] The liquid crystal panel 141 which the 3rd operation gestalt of this invention requires is shown in drawing 5 and drawing 6. With this liquid crystal panel 141, it differs from the 1st operation gestalt in that the protruding piece section 198 is formed also in the optical outgoing radiation side of the maintenance frame 190. Other configurations (the configuration of parts other than maintenance frame 190 and liquid crystal panel 141 is included) are the same as the 1st operation gestalt. In drawing 5 and 6, if attached to the same component as the 1st operation gestalt, the same sign as having used for explanation of the 1st operation gestalt is attached, and the detailed explanation is omitted. It is being fixed to louvering section 192A which the protruding piece section 198 by the side of optical outgoing radiation is the plate-like part material made of resin, and was prepared in the four way type of 192 the 2nd frame by adhesion etc. ( drawing 6 ). In addition, when the protruding piece section 198 is used as a metal member, you may fix to louvering section 192A by solder attachment etc., and the 2nd frame of 192 and the protruding piece section 198 may really be fabricated by resin.

[0033] With such an operation gestalt, there is the following effectiveness by the characteristic configuration.

[0034] (5) By the maintenance frame 190, since the 2nd frame of the protruding piece section 198 is formed also in 192, the cooling air by the side of optical outgoing radiation which flows both by the side of optical incidence and optical outgoing radiation can be certainly hit to a liquid crystal panel 141, and a liquid crystal panel 141 can be efficiently cooled from the both sides by the side of optical ON outgoing radiation.

[0035] The [4th operation gestalt] The liquid crystal panel 141 concerning the 4th operation gestalt of this invention is shown in drawing 7. In the maintenance frame 190 holding this liquid crystal panel 141, the 1st frame of the slot 199 of a cross-section concave which continued in the direction of a vertical is established in 191, and this slot 199 is the air induction part of this invention. And opening 194 is formed in the interior of a slot 199. The depth of a slot 199 etc. is set up so that the cooling air of the air capacity which was suitable in the slot 199 cooling a liquid crystal panel 141 may circulate. Other configurations (the configuration of parts other than maintenance frame 190 and liquid crystal panel 141 is included) are the same as the 1st operation gestalt. In drawing 7, if attached to the same component as the 1st operation gestalt, the same sign as having used for explanation of the 1st operation gestalt is attached, and the detailed explanation is omitted. Here, such a slot may be established in 2nd frame 192 side, and you may prepare in both frames 191,192. Moreover, the soffit side of the 1st frame may be made to extend to the opening 172 for blowdown, and the slot covering this extension section may be formed.

[0036] With such an operation gestalt, by circulating cooling air in a slot 199, the flow of the cooling air which is going to whirl around and is going to spread can be prepared, it can be made to be able to circulate without the

leakage in abbreviation, and (1) or (2) effectiveness mentioned above can be acquired similarly. Moreover, there is the following effectiveness.

[0037] (6) Since the air induction part in this operation gestalt is the slot 199 of a cross-section concave, it does not project from a body part like each operation gestalt mentioned above. Therefore, the clearance between a liquid crystal panel 141 and the condenser lens 138 (drawing 1) by the side of optical incidence etc. can be narrowed, space-saving-ization of liquid crystal panel 141 perimeter is promoted, and the miniaturization of equipment can be realized.

[0038] In addition, this invention is not limited to said operation gestalt, and deformation as shown below etc. is included in this invention including other configurations which can attain the object of this invention.

[0039] For example, with said each operation gestalt, although it considered as parallel mutually, it may be made to be extended toward the downstream (upper part in drawing) of the flow direction of not only this but cooling air, or the wall part of the couple which the protruding piece section 196 of a couple and a slot 199 counter may be prepared so that it may be tapering off. Moreover, the protruding piece section 196 and a slot 199 are formed along the direction of a vertical, and also some may be leaned or you may make it curve to the direction of a vertical so that it may meet in the direction of a whorl of cooling air.

[0040] Furthermore, it is [ improvement / in cooling effectiveness / further ] good in drawing by forming two or more radiation fins in the protruding piece section 196, and, for example, making the heat of a liquid crystal panel 141 radiate heat positively between the protruding piece sections 196 in which cooling air flows.

[0041] The concrete configuration or construction material may be decided to be arbitration in the range which can attain the object of this invention that the air induction part concerning this invention prepares the flow of cooling air, and just prevents diffusion of cooling air in short.

[0042] Moreover, although only the example of the projector which used three light modulation equipments was given with the above-mentioned operation gestalt, this invention is applicable also to the projector which used only one light modulation equipment, the projector using two light modulation equipments, or the projector using four or more light modulation equipments. Moreover, with the above-mentioned operation gestalt, although the liquid crystal panel was used as light modulation equipment, light modulation equipments other than liquid crystal, such as a device using a micro mirror, may be used. Furthermore, although the light modulation equipment of the transparency mold with which optical plane of incidence differs from an optical outgoing radiation side was used with the above-mentioned operation gestalt, the light modulation equipment of the reflective mold with which optical plane of incidence and an optical outgoing radiation side become the same may be used. With the above-mentioned operation gestalt, although only the example of the front type projector which performs projection was given from the direction which observes a screen, this invention can be applied also to the rear type projector which performs projection from an opposite hand further again with the direction which observes a screen.

[0043]

[Effect of the Invention] Since the air induction part which leads cooling air to the maintenance frame holding light modulation equipment, and prepares the negotiation direction is formed according to this invention as stated above, the runoff to everything but cooling and cooling air toward which light modulation equipment inclined can be suppressed, and it is effective in the ability to raise the cooling effectiveness of light modulation equipment certainly.

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## DESCRIPTION OF DRAWINGS

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### [Brief Description of the Drawings]

[Drawing 1] It is the top view showing typically the important section of the projector to which the light modulation equipment concerning the 1st operation gestalt of this invention was applied.

[Drawing 2] It is the perspective view showing the circumference structure of the light modulation equipment of the 1st operation gestalt.

[Drawing 3] It is the whole perspective view showing the light modulation equipment of the 1st operation gestalt.

[Drawing 4] It is the whole perspective view showing the light modulation equipment concerning the 2nd operation gestalt of this invention.

[Drawing 5] It is a whole perspective view from the optical incidence side which shows the light modulation equipment concerning the 3rd operation gestalt of this invention.

[Drawing 6] It is a whole perspective view from the optical outgoing radiation side which shows the light modulation equipment of the 3rd operation gestalt.

[Drawing 7] It is the whole perspective view showing the light modulation equipment concerning the 4th operation gestalt of this invention.

### [Description of Notations]

100 Projector

141,141R, 141G, 141B Liquid crystal panel which is light modulation equipment

172 Opening for Blowdown

190 Maintenance Frame

192 197 Extension section

194 Opening for Optical Incidence

195 Opening for Optical Outgoing Radiation

196 198 The protruding piece section which is an air induction part

199 Slot Which is Air Induction Part

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[Translation done.]